

WHAT IS CLAIMED IS:

1. A method for ex vivo expansion of stem cells, comprising the steps of;

5

(a) culturing said stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:15);

10 wherein Xaa at position 17 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;
 Xaa at position 18 is Asn, His, Leu, Ile, Phe, Arg, or Gln;
 Xaa at position 19 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;
 Xaa at position 20 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;
 15 Xaa at position 21 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;
 Xaa at position 22 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val or Gly;
 Xaa at position 23 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,
 20 Ser, or Arg;
 Xaa at position 24 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
 Xaa at position 25 is Thr, His, Gly, Gln, Arg, Pro, or Ala;
 Xaa at position 26 is His, Thr, Phe, Gly, Arg, Ala, or Trp;
 Xaa at position 27 is Leu, Gly, Arg, Thr, Ser, or Ala;
 25 Xaa at position 28 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;
 Xaa at position 29 is Gln, Asn, Leu, Pro, Arg, or Val;
 Xaa at position 30 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;
 Xaa at position 31 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
 30 Xaa at position 32 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;
 Xaa at position 33 is Pro, Leu, Gln, Ala, Thr, or Glu;
 Xaa at position 34 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;
 Xaa at position 35 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;
 35 Xaa at position 36 is Asp, Leu, or Val;
 Xaa at position 37 is Phe, Ser, Pro, Trp, or Ile;
 Xaa at position 38 is Asn, or Ala;
 Xaa at position 40 is Leu, Trp, or Arg;

- Xaa at position 41 is Asn, Cys, Arg, Leu, His, Met, or Pro;
- Xaa at position 42 is Gly, Asp, Ser, Cys, Asn, Lys, Thr, Leu, Val,
Glu, Phe, Tyr, Ile, Met or Ala;
- Xaa at position 43 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,
5 Arg, Thr, Gly or Ser;
- Xaa at position 44 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,
Asn, Gln, Ala or Pro;
- Xaa at position 45 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Trp,
Asp, Asn, Arg, Ser, Ala, Ile, Glu or His;
- 10 Xaa at position 46 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys,
His, Ala, Tyr, Ile, Val or Gly;
- Xaa at position 47 is Ile, Gly, Val, Ser, Arg, Pro, or His;
- Xaa at position 48 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys,
Thr, Ala, Met, Val or Asn;
- 15 Xaa at position 49 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;
- Xaa at position 50 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,
Ile, Val, His, Phe, Met or Gln;
- Xaa at position 51 is Asn, Arg, Met, Pro, Ser, Thr, or His;
- Xaa at position 52 is Asn, His, Arg, Leu, Gly, Ser, or Thr;
- 20 Xaa at position 53 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, or
Met;
- Xaa at position 54 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys,
His, Ala or Leu;
- Xaa at position 55 is Arg, Thr, Val, Ser, Leu, or Gly;
- 25 Xaa at position 56 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,
Thr, Ala, Tyr, Phe, Leu, Val or Lys;
- Xaa at position 57 is Asn or Gly;
- Xaa at position 58 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- Xaa at position 59 is Glu, Tyr, His, Leu, Pro, or Arg;
- 30 Xaa at position 60 is Ala, Ser, Pro, Tyr, Asn, or Thr;
- Xaa at position 61 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
- Xaa at position 62 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
- Xaa at position 63 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- Xaa at position 64 is Ala, Asn, Pro, Ser, or Lys;
- 35 Xaa at position 65 is Val, Thr, Pro, His, Leu, Phe, or Ser;
- Xaa at position 66 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
- Xaa at position 67 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or
His;

- Xaa at position 68 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
 Xaa at position 69 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or
 Leu;
- Xaa at position 70 is Asn, Leu, Val, Trp, Pro, or Ala;
- 5 Xaa at position 71 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln,
 Trp, or Asn;
- Xaa at position 72 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
 Xaa at position 73 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
 Xaa at position 74 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
- 10 Xaa at position 75 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser,
 Gln, or Leu;
- Xaa at position 76 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or
 Asp;
- Xaa at position 77 is Ile, Ser, Arg, Thr, or Leu;
- 15 Xaa at position 78 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
 Xaa at position 79 is Lys, Thr, Asn, Met, Arg, Ile, Gly, or
 Asp;
- Xaa at position 80 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;
 Xaa at position 81 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;
- 20 Xaa at position 82 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His,
 Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
- Xaa at position 83 is Pro, Ala, Thr, Trp, Arg, or Met;
 Xaa at position 84 is Cys, Glu, Gly, Arg, Met, or Val;
 Xaa at position 85 is Leu, Asn, Val, or Gln;
- 25 Xaa at position 86 is Pro, Cys, Arg, Ala, or Lys;
 Xaa at position 87 is Leu, Ser, Trp, or Gly;
 Xaa at position 88 is Ala, Lys, Arg, Val, or Trp;
 Xaa at position 89 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or
 Ser;
- 30 Xaa at position 90 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;
 Xaa at position 91 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;
 Xaa at position 92 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile
 or Leu;
- Xaa at position 93 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
- 35 Xaa at position 94 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,
 Ala, or Pro;
- Xaa at position 95 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,
 Lys, Ser, Ala, Trp, Phe, Ile, or Tyr;

- Xaa at position 96 is Pro, Lys, Tyr, Gly, Ile, or Thr;
Xaa at position 97 is Ile, Val, Lys, Ala, or Asn;
Xaa at position 98 is His, Ile, Asn, Leu, Asp, Ala, Thr,
Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- 5 Xaa at position 99 is Ile, Leu, Arg, Asp, Val, Pro, Gln,
Gly, Ser, Phe, or His;
Xaa at position 100 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,
or Pro;
Xaa at position 101 is Asp, Pro, Met, Lys, His, Thr, Val,
10 Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu, or Gln;
Xaa at position 102 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
Xaa at position 103 is Asp, or Ser;
Xaa at position 104 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,
Gln, Lys, Ala, Phe, or Gly;
- 15 Xaa at position 105 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,
Leu, Lys, Ile, Asp, or His;
Xaa at position 106 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
Xaa at position 108 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser,
Ala or Pro;
- 20 Xaa at position 109 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
Xaa at position 110 is Lys, Ala, Asn, Thr, Leu, Arg, Gln, His, Glu,
Ser, or Trp;
Xaa at position 111 is Leu, Ile, Arg, Asp, or Met;
Xaa at position 112 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- 25 Xaa at position 113 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,
Lys, Leu, Ile, Val or Asn;
Xaa at position 114 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
Xaa at position 115 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,
Trp, or Met;
- 30 Xaa at position 116 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu,
Arg, Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;
Xaa at position 117 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
Xaa at position 118 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
Xaa at position 119 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;
- 35 Xaa at position 120 is Asn, Ala, Pro, Leu, His, Val, or Gln;
Xaa at position 121 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or
Gly;
Xaa at position 122 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,

Ile, Tyr, or Cys;

Xaa at position 123 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by
 5 Xaa are different from the corresponding amino acids of
 native (1-133) human interleukin-3; wherein from 1 to
 14 amino acids can be deleted from the N-terminus
 and/or from 1 to 15 amino acids can be deleted from the
 C-terminus of said interleukin-3 mutant polypeptide;
 10 and said interleukin-3 mutant polypeptide can
 additionally be immediately preceded by Methionine⁻¹,
 Alanine⁻¹ or Methionine⁻² Alanine⁻¹; and

(b) harvesting said cultured stem cells.

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2. A method for ex vivo expansion of stem cells,
 comprising the steps of;

(a) culturing said stem cells with a selected
 20 growth medium comprising a human interleukin-3 mutant
 polypeptide of [SEQ ID NO:19];

wherein

Xaa at position 3 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;
 25 Xaa at position 4 is Asn, His, Leu, Ile, Phe, Arg, or Gln;
 Xaa at position 5 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;
 Xaa at position 6 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;
 Xaa at position 7 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn,
 Thr, Ser or Val;
 30 Xaa at position 8 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln,
 Leu, Val, or Gly;
 Xaa at position 9 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,
 Ser, or Arg;
 Xaa at position 10 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
 35 Xaa at position 11 is Thr, His, Gly, Gln, Arg, Pro, or Ala;
 Xaa at position 12 is His, Thr, Phe, Gly, Arg, Ala, or Trp;
 Xaa at position 13 is Leu, Gly, Arg, Thr, Ser, or Ala;
 Xaa at position 14 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;

- Xaa at position 15 is Gln, Asn, Leu, Pro, Arg, or Val;
 Xaa at position 16 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;
- Xaa at position 17 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
- 5 Xaa at position 18 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;
 Xaa at position 19 is Pro, Leu, Gln, Ala, Thr, or Glu;
 Xaa at position 20 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;
- Xaa at position 21 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;
- 10 Xaa at position 22 is Asp, Leu, or Val;
 Xaa at position 23 is Phe, Ser, Pro, Trp, or Ile;
 Xaa at position 24 is Asn, or Ala;
 Xaa at position 26 is Leu, Trp, or Arg;
 Xaa at position 27 is Asn, Cys, Arg, Leu, His, Met, Pro;
- 15 Xaa at position 28 is Gly, Asp, Ser, Cys, Ala, Lys, Asn, Thr, Leu, Val, Glu, Phe, Tyr, Ile or Met;
 Xaa at position 29 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln, Arg, Thr, Gly or Ser;
 Xaa at position 30 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu, Asn, Gln, Ala or Pro;
- 20 Xaa at position 31 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Asp, Asn, Arg, Ser, Ala, Ile, Glu, His or Trp;
 Xaa at position 32 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys, His, Ala, Tyr, Ile, Val or Gly;
- 25 Xaa at position 33 is Ile, Gly, Val, Ser, Arg, Pro, or His;
 Xaa at position 34 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys, Thr, Ala, Met, Val or Asn;
- Xaa at position 35 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;
 Xaa at position 36 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala, Ile, Val, His, Phe, Met or Gln;
- 30 Xaa at position 37 is Asn, Arg, Met, Pro, Ser, Thr, or His;
 Xaa at position 38 is Asn, His, Arg, Leu, Gly, Ser, or Thr;
 Xaa at position 39 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, Met, or;
- 35 Xaa at position 40 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys, His, Ala or Leu;
 Xaa at position 41 is Arg, Thr, Val, Ser, Leu, or Gly;
 Xaa at position 42 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,

Thr, Ala, Tyr, Phe, Leu, Val or Lys;

- Xaa at position 43 is Asn or Gly;
- Xaa at position 44 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- Xaa at position 45 is Glu, Tyr, His, Leu, Pro, or Arg;
- 5 Xaa at position 46 is Ala, Ser, Pro, Tyr, Asn, or Thr;
- Xaa at position 47 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
- Xaa at position 48 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
- Xaa at position 49 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- Xaa at position 50 is Ala, Asn, Pro, Ser, or Lys;
- 10 Xaa at position 51 is Val, Thr, Pro, His, Leu, Phe, or Ser;
- Xaa at position 52 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
- Xaa at position 53 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;
- Xaa at position 54 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
- 15 Xaa at position 55 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;
- Xaa at position 56 is Asn, Leu, Val, Trp, Pro, or Ala;
- Xaa at position 57 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
- 20 Xaa at position 58 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
- Xaa at position 59 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
- Xaa at position 60 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
- Xaa at position 61 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
- 25 Xaa at position 62 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;
- Xaa at position 63 is Ile, Ser, Arg, Thr, or Leu;
- Xaa at position 64 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
- Xaa at position 65 is Lys, Thr, Gly, Asn, Met, Arg, Ile, or Asp;
- 30 Xaa at position 66 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;
- Xaa at position 67 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;
- Xaa at position 68 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
- 35 Xaa at position 69 is Pro, Ala, Thr, Trp, Arg, or Met;
- Xaa at position 70 is Cys, Glu, Gly, Arg, Met, or Val;
- Xaa at position 71 is Leu, Asn, Val, or Gln;
- Xaa at position 72 is Pro, Cys, Arg, Ala, or Lys;

- Xaa at position 73 is Leu, Ser, Trp, or Gly;
 Xaa at position 74 is Ala, Lys, Arg, Val, or Trp;
 Xaa at position 75 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;
- 5 Xaa at position 76 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;
 Xaa at position 77 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;
 Xaa at position 78 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;
- Xaa at position 79 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
- 10 Xaa at position 80 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His, Ala or Pro;
 Xaa at position 81 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn, Lys, Ser, Ala, Trp, Phe, Ile or Tyr;
- Xaa at position 82 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- 15 Xaa at position 83 is Ile, Val, Lys, Ala, or Asn;
 Xaa at position 84 is His, Ile, Asn, Leu, Asp, Ala, Thr, Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- Xaa at position 85 is Ile, Leu, Arg, Asp, Val, Pro, Gln, Gly, Ser, Phe, or His;
- 20 Xaa at position 86 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln, Pro;
 Xaa at position 87 is Asp, Pro, Met, Lys, His, Thr, Val, Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu or Gln;
- Xaa at position 88 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- 25 Xaa at position 89 is Asp, or Ser;
 Xaa at position 90 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu, Gln, Lys, Ala, Phe, or Gly;
- Xaa at position 91 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr, Leu, Lys, Ile, Asp, or His;
- 30 Xaa at position 92 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
 Xaa at position 94 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser, Ala, or Pro;
- Xaa at position 95 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
 Xaa at position 96 is Lys, Asn, Thr, Leu, Gln, Arg, His, Glu, Ser, Ala or Trp;
- 35 Xaa at position 97 is Leu, Ile, Arg, Asp, or Met;
 Xaa at position 98 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
 Xaa at position 99 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,

Lys, Leu, Ile, Val or Asn;

Xaa at position 100 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;

Xaa at position 101 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,
Trp, or Met;

5 Xaa at position 102 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu, Arg,
Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;

Xaa at position 103 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;

Xaa at position 104 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;

Xaa at position 105 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;

10 Xaa at position 106 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 107 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or
Gly;

Xaa at position 108 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,
Ile, Tyr, or Cys;

15 Xaa at position 109 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by
Xaa are different from the corresponding amino acids of
native (1-133) human interleukin-3; and said

20 interleukin-3 mutant polypeptide can additionally be
immediately preceded by Methionine⁻¹, Alanine⁻¹ or
Methionine⁻² Alanine⁻¹; and

(b) harvesting said cultured stem cells.

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3. A method for ex vivo expansion of stem cells,
comprising the steps of;

(a) culturing said stem cells with a selected
30 growth medium comprising a human interleukin-3 mutant
polypeptide of (SEQ ID NO:129);

wherein m is 0 or 1; Xaa at position 18 is Asn or Ile;
Xaa at position 19 is Met, Ala or Ile; Xaa at position
35 20 is Ile, Pro or Leu; Xaa at position 23 is Ile, Ala
or Leu; Xaa at position 25 is Thr or His; Xaa at
position 29 is Gln, Arg, Val or Leu; Xaa at position 32
is Leu, Ala, Asn or Arg; Xaa at position 34 is Leu or

Ser; Xaa at position 37 is Phe, Pro, or Ser; Xaa at position 38 is Asn or Ala; Xaa at position 42 is Gly, Ala, Ser, Asp or Asn; Xaa at position 45 is Gln, Val, or Met; Xaa at position 46 is Asp or Ser; Xaa at position 49 is Met, Ile, Leu or Asp; Xaa at position 50 is Glu or Asp; Xaa at position 51 is Asn Arg or Ser; Xaa at position 55 is Arg, Leu, or Thr; Xaa at position 56 is Pro or Ser; Xaa at position 59 is Glu or Leu; Xaa at position 60 is Ala or Ser; Xaa at position 62 is Asn, Val or Pro; Xaa at position 63 is Arg or His; Xaa at position 65 is Val or Ser; Xaa at position 67 is Ser, Asn, His or Gly; Xaa at position 69 is Gln or Glu; Xaa at position 73 is Ala or Gly; Xaa at position 76 is Ser, Ala or Pro; Xaa at position 79 is Lys, Arg or Ser; Xaa at position 82 is Leu, Glu, Val or Trp; Xaa at position 85 is Leu or Val; Xaa at position 87 is Leu, Ser, or Trp; Xaa at position 88 is Ala or Trp; Xaa at position 91 is Ala or Pro; Xaa at position 93 is Pro or Ser; Xaa at position 95 is His or Thr; Xaa at position 98 is His, Ile, or Thr; Xaa at position 100 is Lys or Arg; Xaa at position 101 is Asp, Ala or Met; Xaa at position 105 is Asn or Gln; Xaa at position 109 is Arg, Glu or Leu; Xaa at position 112 is Thr or Gln; Xaa at position 116 is Lys, Val, Trp or Ser; Xaa at position 117 is Thr or Ser; Xaa at position 120 is Asn, Gln, or His; Xaa at position 123 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native human interleukin-3; and

(b) harvesting said cultured stem cells.

4. A method for ex vivo expansion of stem cells, comprising the steps of; (a) culturing said stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:130);

wherein m is 0 or 1; n is 0 or 1; p is 0 or 1; Xaa at position 4 is Asn or Ile; Xaa at position 5 is Met, Ala

or Ile; Xaa at position 6 is Ile, Pro or Leu; Xaa at
 position 9 is Ile, Ala or Leu; Xaa at position 11 is
 Thr or His; Xaa at position 15 is Gln, Arg, Val or Leu;
 Xaa at position 18 is Leu, Ala, Asn or Arg; Xaa at
 5 position 20 is Leu or Ser; Xaa at position 23 is Phe,
 Pro, or Ser; Xaa at position 24 is Asn or Ala; Xaa at
 position 28 is Gly, Ala, Ser, Asp or Asn; Xaa at
 position 31 is Gln, Val, or Met; Xaa at position 32 is
 Asp or Ser; Xaa at position 35 is Met, Ile, Leu or Asp;
 10 Xaa at position 36 is Glu or Asp; Xaa at position 37 is
 Asn, Arg or Ser; Xaa at position 41 is Arg, Leu, or
 Thr; Xaa at position 42 is Pro or Ser; Xaa at position
 45 is Glu or Leu; Xaa at position 46 is Ala or Ser; Xaa
 at position 48 is Asn, Val or Pro; Xaa at position 49
 15 is Arg or His; Xaa at position 51 is Val or Ser; Xaa at
 position 53 is Ser, Asn, His or Gly; Xaa at position 55
 is Gln or Glu; Xaa at position 59 is Ala or Gly; Xaa at
 position 62 is Ser, Ala or Pro; Xaa at position 65 is
 Lys, Arg or Ser; Xaa at position 67 is Leu, Glu, or
 20 Val; Xaa at position 68 is Leu, Glu, Val or Trp; Xaa
 at position 71 is Leu or Val; Xaa at position 73 is
 Leu, Ser or Trp; Xaa at position 74 is Ala or Trp; Xaa
 at position 77 is Ala or Pro; Xaa at position 79 is Pro
 or Ser; Xaa at position 81 is His or Thr; Xaa at
 25 position 84 is His, Ile, or Thr; Xaa at position 86 is
 Lys or Arg; Xaa at position 87 is Asp, Ala or Met; Xaa
 at position 91 is Asn or Gln; Xaa at position 95 is
 Arg, Glu, Leu; Xaa at position 98 Thr or Gln; Xaa at
 position 102 is Lys, Val, Trp or Ser; Xaa at position
 30 103 is Thr or Ser; Xaa at position 106 is Asn, Gln, or
 His; Xaa at position 109 is Ala or Glu; with the
 proviso that from four to forty-four of the amino acids
 designated by Xaa are different from the corresponding
 amino acids of native (1-133) human interleukin-3; and

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(b) harvesting said cultured stem cells.

5. The method according to Claim 2 wherein said

interleukin-3 mutant polypeptide is selected from the group consisting of:

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 5 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 Glu Asp Val Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 10 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:66);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 15 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 20 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:67);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 25 Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 30 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:68);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 35 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys

Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:69);

5

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
10 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:70);

15

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
20 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:71);

25

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
30 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:72);

35

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro

Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr
 5 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:73);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 10 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr
 15 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:74);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 20 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr
 25 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln
 (SEQ ID NO:75);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 30 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 35 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:76);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys

Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
 5 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:77);

10 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
 15 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln
 (SEQ ID NO:78);

20 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 25 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:79);

30 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 35 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:80);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 5 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 10 (SEQ ID NO:81);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
 15 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 20 Gln (SEQ ID NO:82);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
 25 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 30 Gln (SEQ ID NO:83);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
 35 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys

Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:84);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
5 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
10 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:85);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
15 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
20 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:86);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
25 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
30 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:87);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
35 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln

Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:88);

5

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
10 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:89);

15

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
20 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:90);

25

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
30 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:91);

35

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg

Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
5 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:92);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
10 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
15 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:93);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
20 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
25 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:94);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
30 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
35 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:95);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His

Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 5 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
 Gln (SEQ ID NO:96);

10 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg
 Leu Ser Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 15 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:296);

20 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ala Ile His His
 Leu Lys Arg Pro Pro Ala Pro Ser Leu Asp Pro Asn Asn Leu
 Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 25 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:300);

30 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 35 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:301);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg
 5 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 10 Gln (SEQ ID NO:308);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Asp Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
 15 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 20 Gln (SEQ ID NO:309);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
 25 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 30 Gln (SEQ ID NO:310);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys
 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 35 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile

Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:315);

5 Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys
 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
 10 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:316); and

15 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Leu Ile His His
 Leu Lys Ile Pro Pro Asn Pro Ser Leu Asp Ser Ala Asn Leu
 Asn Ser Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
 20 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:318).

25

6. The method of claim 66 wherein said mutant
 human interleukin-3 polypeptide has at least three
 times greater activity than native human interleukin-3,
 in at least one assay selected from the group
 30 consisting of: AML cell proliferation, TF-1 cell
 proliferation and Methylcellulose assay.

7. The method of claim 1 further comprising the
 step of separating the stem cells from a mixed
 35 population of cells prior to culturing the stem cells.

8. The method of claim 7 wherein said stem cells
 are separated from a mixed population of cells based on

the stem cells having CD34 surface antigen.

9. Cultured stem cells obtained by the method of claim 1, 2, 3, 4, 5, 6, 7, or 8.

5

10. A method of human gene therapy, comprising the steps of;

(a) culturing stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:15);

wherein Xaa at position 17 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;

15 Xaa at position 18 is Asn, His, Leu, Ile, Phe, Arg, or Gln;
Xaa at position 19 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;
Xaa at position 20 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;
Xaa at position 21 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;

20 Xaa at position 22 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val or Gly;
Xaa at position 23 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe, Ser, or Arg;

Xaa at position 24 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
25 Xaa at position 25 is Thr, His, Gly, Gln, Arg, Pro, or Ala;
Xaa at position 26 is His, Thr, Phe, Gly, Arg, Ala, or Trp;
Xaa at position 27 is Leu, Gly, Arg, Thr, Ser, or Ala;
Xaa at position 28 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;
Xaa at position 29 is Gln, Asn, Leu, Pro, Arg, or Val;

30 Xaa at position 30 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;

Xaa at position 31 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
Xaa at position 32 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;
Xaa at position 33 is Pro, Leu, Gln, Ala, Thr, or Glu;
35 Xaa at position 34 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;

Xaa at position 35 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;

Xaa at position 36 is Asp, Leu, or Val;

- Xaa at position 37 is Phe, Ser, Pro, Trp, or Ile;
 Xaa at position 38 is Asn, or Ala;
 Xaa at position 40 is Leu, Trp, or Arg;
 Xaa at position 41 is Asn, Cys, Arg, Leu, His, Met, or Pro;
 5 Xaa at position 42 is Gly, Asp, Ser, Cys, Asn, Lys, Thr, Leu, Val,
 Glu, Phe, Tyr, Ile, Met or Ala;
 Xaa at position 43 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,
 Arg, Thr, Gly or Ser;
 Xaa at position 44 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,
 10 Asn, Gln, Ala or Pro;
 Xaa at position 45 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Trp,
 Asp, Asn, Arg, Ser, Ala, Ile, Glu or His;
 Xaa at position 46 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys,
 His, Ala, Tyr, Ile, Val or Gly;
 15 Xaa at position 47 is Ile, Gly, Val, Ser, Arg, Pro, or His;
 Xaa at position 48 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys,
 Thr, Ala, Met, Val or Asn;
 Xaa at position 49 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;
 Xaa at position 50 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,
 20 Ile, Val, His, Phe, Met or Gln;
 Xaa at position 51 is Asn, Arg, Met, Pro, Ser, Thr, or His;
 Xaa at position 52 is Asn, His, Arg, Leu, Gly, Ser, or Thr;
 Xaa at position 53 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, or
 Met;
 25 Xaa at position 54 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys,
 His, Ala or Leu;
 Xaa at position 55 is Arg, Thr, Val, Ser, Leu, or Gly;
 Xaa at position 56 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,
 Thr, Ala, Tyr, Phe, Leu, Val or Lys;
 30 Xaa at position 57 is Asn or Gly;
 Xaa at position 58 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
 Xaa at position 59 is Glu, Tyr, His, Leu, Pro, or Arg;
 Xaa at position 60 is Ala, Ser, Pro, Tyr, Asn, or Thr;
 Xaa at position 61 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
 35 Xaa at position 62 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
 Xaa at position 63 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
 Xaa at position 64 is Ala, Asn, Pro, Ser, or Lys;
 Xaa at position 65 is Val, Thr, Pro, His, Leu, Phe, or Ser;

- Xaa at position 66 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
 Xaa at position 67 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;
- Xaa at position 68 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
- 5 Xaa at position 69 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;
- Xaa at position 70 is Asn, Leu, Val, Trp, Pro, or Ala;
 Xaa at position 71 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
- 10 Xaa at position 72 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
 Xaa at position 73 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
 Xaa at position 74 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
 Xaa at position 75 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
- 15 Xaa at position 76 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;
 Xaa at position 77 is Ile, Ser, Arg, Thr, or Leu;
 Xaa at position 78 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
 Xaa at position 79 is Lys, Thr, Asn, Met, Arg, Ile, Gly, or Asp;
- 20 Xaa at position 80 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;
 Xaa at position 81 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;
 Xaa at position 82 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
- 25 Xaa at position 83 is Pro, Ala, Thr, Trp, Arg, or Met;
 Xaa at position 84 is Cys, Glu, Gly, Arg, Met, or Val;
 Xaa at position 85 is Leu, Asn, Val, or Gln;
 Xaa at position 86 is Pro, Cys, Arg, Ala, or Lys;
 Xaa at position 87 is Leu, Ser, Trp, or Gly;
- 30 Xaa at position 88 is Ala, Lys, Arg, Val, or Trp;
 Xaa at position 89 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;
- Xaa at position 90 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;
 Xaa at position 91 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;
- 35 Xaa at position 92 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;
- Xaa at position 93 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
 Xaa at position 94 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,

- Ala, or Pro;
- Xaa at position 95 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,
Lys, Ser, Ala, Trp, Phe, Ile, or Tyr;
- Xaa at position 96 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- 5 Xaa at position 97 is Ile, Val, Lys, Ala, or Asn;
- Xaa at position 98 is His, Ile, Asn, Leu, Asp, Ala, Thr,
Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- Xaa at position 99 is Ile, Leu, Arg, Asp, Val, Pro, Gln,
Gly, Ser, Phe, or His;
- 10 Xaa at position 100 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,
or Pro;
- Xaa at position 101 is Asp, Pro, Met, Lys, His, Thr, Val,
Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu, or Gln;
- Xaa at position 102 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- 15 Xaa at position 103 is Asp, or Ser;
- Xaa at position 104 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,
Gln, Lys, Ala, Phe, or Gly;
- Xaa at position 105 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,
Leu, Lys, Ile, Asp, or His;
- 20 Xaa at position 106 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
- Xaa at position 108 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser,
Ala or Pro;
- Xaa at position 109 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
- Xaa at position 110 is Lys, Ala, Asn, Thr, Leu, Arg, Gln, His, Glu,
25 Ser, or Trp;
- Xaa at position 111 is Leu, Ile, Arg, Asp, or Met;
- Xaa at position 112 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- Xaa at position 113 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,
Lys, Leu, Ile, Val or Asn;
- 30 Xaa at position 114 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
- Xaa at position 115 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,
Trp, or Met;
- Xaa at position 116 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu,
Arg, Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;
- 35 Xaa at position 117 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
- Xaa at position 118 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
- Xaa at position 119 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;
- Xaa at position 120 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 121 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or Gly;

Xaa at position 122 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His, Ile, Tyr, or Cys;

5 Xaa at position 123 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by Xaa are different from the corresponding amino acids of native (1-133) human interleukin-3; wherein from 1 to
10 14 amino acids can be deleted from the N-terminus and/or from 1 to 15 amino acids can be deleted from the C-terminus of said interleukin-3 mutant polypeptide; and said interleukin-3 mutant polypeptide can additionally be immediately preceded by Methionine⁻¹,
15 Alanine⁻¹ or Methionine⁻² Alanine⁻¹; and

(b) transducing DNA into said cultured cells;
(c) harvesting said transduced cells; and
(d) transplanting said transduced cells into said
20 patient.

11. A method of human gene therapy, comprising the steps of;

25 (a) culturing stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of [SEQ ID NO:19];

wherein

30 Xaa at position 3 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;
Xaa at position 4 is Asn, His, Leu, Ile, Phe, Arg, or Gln;
Xaa at position 5 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;
Xaa at position 6 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;
Xaa at position 7 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn,
35 Thr, Ser or Val;
Xaa at position 8 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val, or Gly;
Xaa at position 9 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,

Ser, or Arg;

- Xaa at position 10 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
 Xaa at position 11 is Thr, His, Gly, Gln, Arg, Pro, or Ala;
 Xaa at position 12 is His, Thr, Phe, Gly, Arg, Ala, or Trp;
 5 Xaa at position 13 is Leu, Gly, Arg, Thr, Ser, or Ala;
 Xaa at position 14 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;
 Xaa at position 15 is Gln, Asn, Leu, Pro, Arg, or Val;
 Xaa at position 16 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or
 Lys;
 10 Xaa at position 17 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
 Xaa at position 18 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;
 Xaa at position 19 is Pro, Leu, Gln, Ala, Thr, or Glu;
 Xaa at position 20 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr,
 Arg, Ala, Phe, Ile or Met;
 15 Xaa at position 21 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;
 Xaa at position 22 is Asp, Leu, or Val;
 Xaa at position 23 is Phe, Ser, Pro, Trp, or Ile;
 Xaa at position 24 is Asn, or Ala;
 Xaa at position 26 is Leu, Trp, or Arg;
 20 Xaa at position 27 is Asn, Cys, Arg, Leu, His, Met, Pro;
 Xaa at position 28 is Gly, Asp, Ser, Cys, Ala, Lys, Asn, Thr, Leu,
 Val, Glu, Phe, Tyr, Ile or Met;
 Xaa at position 29 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,
 Arg, Thr, Gly or Ser;
 25 Xaa at position 30 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,
 Asn, Gln, Ala or Pro;
 Xaa at position 31 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Asp,
 Asn, Arg, Ser, Ala, Ile, Glu, His or Trp;
 Xaa at position 32 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln,
 30 Lys, His, Ala, Tyr, Ile, Val or Gly;
 Xaa at position 33 is Ile, Gly, Val, Ser, Arg, Pro, or His;
 Xaa at position 34 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu,
 Lys, Thr, Ala, Met, Val or Asn;
 Xaa at position 35 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;
 35 Xaa at position 36 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,
 Ile, Val, His, Phe, Met or Gln;
 Xaa at position 37 is Asn, Arg, Met, Pro, Ser, Thr, or His;
 Xaa at position 38 is Asn, His, Arg, Leu, Gly, Ser, or Thr;

- Xaa at position 39 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser,
Met, or;
- Xaa at position 40 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn,
Lys, His, Ala or Leu;
- 5 Xaa at position 41 is Arg, Thr, Val, Ser, Leu, or Gly;
Xaa at position 42 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,
Thr, Ala, Tyr, Phe, Leu, Val or Lys;
Xaa at position 43 is Asn or Gly;
Xaa at position 44 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- 10 Xaa at position 45 is Glu, Tyr, His, Leu, Pro, or Arg;
Xaa at position 46 is Ala, Ser, Pro, Tyr, Asn, or Thr;
Xaa at position 47 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
Xaa at position 48 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
Xaa at position 49 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- 15 Xaa at position 50 is Ala, Asn, Pro, Ser, or Lys;
Xaa at position 51 is Val, Thr, Pro, His, Leu, Phe, or Ser;
Xaa at position 52 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
Xaa at position 53 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or
His;
- 20 Xaa at position 54 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
Xaa at position 55 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or
Leu;
Xaa at position 56 is Asn, Leu, Val, Trp, Pro, or Ala;
Xaa at position 57 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln,
Trp, or Asn;
- 25 Xaa at position 58 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
Xaa at position 59 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
Xaa at position 60 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
Xaa at position 61 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser,
Gln, or Leu;
- 30 Xaa at position 62 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or
Asp;
Xaa at position 63 is Ile, Ser, Arg, Thr, or Leu;
Xaa at position 64 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
- 35 Xaa at position 65 is Lys, Thr, Gly, Asn, Met, Arg, Ile, or
Asp;
Xaa at position 66 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;
Xaa at position 67 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;

- Xaa at position 68 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn,
His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
- Xaa at position 69 is Pro, Ala, Thr, Trp, Arg, or Met;
- Xaa at position 70 is Cys, Glu, Gly, Arg, Met, or Val;
- 5 Xaa at position 71 is Leu, Asn, Val, or Gln;
- Xaa at position 72 is Pro, Cys, Arg, Ala, or Lys;
- Xaa at position 73 is Leu, Ser, Trp, or Gly;
- Xaa at position 74 is Ala, Lys, Arg, Val, or Trp;
- Xaa at position 75 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or
10 Ser;
- Xaa at position 76 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;
- Xaa at position 77 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;
- Xaa at position 78 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile
or Leu;
- 15 Xaa at position 79 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
- Xaa at position 80 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,
Ala or Pro;
- Xaa at position 81 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,
Lys, Ser, Ala, Trp, Phe, Ile or Tyr;
- 20 Xaa at position 82 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- Xaa at position 83 is Ile, Val, Lys, Ala, or Asn;
- Xaa at position 84 is His, Ile, Asn, Leu, Asp, Ala, Thr, Glu,
Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- Xaa at position 85 is Ile, Leu, Arg, Asp, Val, Pro, Gln,
25 Gly, Ser, Phe, or His;
- Xaa at position 86 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,
Pro;
- Xaa at position 87 is Asp, Pro, Met, Lys, His, Thr, Val,
Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu or Gln;
- 30 Xaa at position 88 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- Xaa at position 89 is Asp, or Ser;
- Xaa at position 90 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,
Gln, Lys, Ala, Phe, or Gly;
- Xaa at position 91 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,
35 Leu, Lys, Ile, Asp, or His;
- Xaa at position 92 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
- Xaa at position 94 is Arg, Lys, Asp, Leu, Thr, Ile, Gln,
His, Ser, Ala, or Pro;

Xaa at position 95 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;

Xaa at position 96 is Lys, Asn, Thr, Leu, Gln, Arg,

His, Glu, Ser, Ala or Trp;

Xaa at position 97 is Leu, Ile, Arg, Asp, or Met;

5 Xaa at position 98 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;

Xaa at position 99 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,

Lys, Leu, Ile, Val or Asn;

Xaa at position 100 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;

Xaa at position 101 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,

10 Trp, or Met;

Xaa at position 102 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu, Arg,

Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;

Xaa at position 103 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;

Xaa at position 104 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;

15 Xaa at position 105 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;

Xaa at position 106 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 107 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or

Gly;

Xaa at position 108 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,

20 Ile, Tyr, or Cys;

Xaa at position 109 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by
Xaa are different from the corresponding amino acids of
25 native (1-133) human interleukin-3; and said
interleukin-3 mutant polypeptide can additionally be
immediately preceded by Methionine⁻¹, Alanine⁻¹ or
Methionine⁻² Alanine⁻¹; and

30 (b) transducing DNA into said cultured cells;

(c) harvesting said transduced cells; and

(d) transplanting said transduced cells into said
patient.

35 12. A method of human gene therapy, comprising
the steps of;

(a) culturing stem cells with a selected growth

medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:129);

wherein m is 0 or 1; Xaa at position 18 is Asn or Ile;
5 Xaa at position 19 is Met, Ala or Ile; Xaa at position 20 is Ile, Pro or Leu; Xaa at position 23 is Ile, Ala or Leu; Xaa at position 25 is Thr or His; Xaa at position 29 is Gln, Arg, Val or Leu; Xaa at position 32 is Leu, Ala, Asn or Arg; Xaa at position 34 is Leu or
10 Ser; Xaa at position 37 is Phe, Pro, or Ser; Xaa at position 38 is Asn or Ala; Xaa at position 42 is Gly, Ala, Ser, Asp or Asn; Xaa at position 45 is Gln, Val, or Met; Xaa at position 46 is Asp or Ser; Xaa at position 49 is Met, Ile, Leu or Asp; Xaa at position 50
15 is Glu or Asp; Xaa at position 51 is Asn Arg or Ser; Xaa at position 55 is Arg, Leu, or Thr; Xaa at position 56 is Pro or Ser; Xaa at position 59 is Glu or Leu; Xaa at position 60 is Ala or Ser; Xaa at position 62 is Asn, Val or Pro; Xaa at position 63 is Arg or His; Xaa
20 at position 65 is Val or Ser; Xaa at position 67 is Ser, Asn, His or Gly; Xaa at position 69 is Gln or Glu; Xaa at position 73 is Ala or Gly; Xaa at position 76 is Ser, Ala or Pro; Xaa at position 79 is Lys, Arg or Ser; Xaa at position 82 is Leu, Glu, Val or Trp; Xaa at
25 position 85 is Leu or Val; Xaa at position 87 is Leu, Ser, or Trp; Xaa at position 88 is Ala or Trp; Xaa at position 91 is Ala or Pro; Xaa at position 93 is Pro or Ser; Xaa at position 95 is His or Thr; Xaa at position 98 is His, Ile, or Thr; Xaa at position 100 is Lys or
30 Arg; Xaa at position 101 is Asp, Ala or Met; Xaa at position 105 is Asn or Gln; Xaa at position 109 is Arg, Glu or Leu; Xaa at position 112 is Thr or Gln; Xaa at position 116 is Lys, Val, Trp or Ser; Xaa at position 117 is Thr or Ser; Xaa at position 120 is Asn, Gln, or
35 His; Xaa at position 123 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native human interleukin-3; and

- (b) transducing DNA into said cultured cells;
 - (c) harvesting said transduced cells; and
 - (d) transplanting said transduced cells into said
- 5 patient.

13. A method of human gene therapy, comprising the steps of;

10

(a) culturing stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:130);

15 wherein m is 0 or 1; n is 0 or 1; p is 0 or 1; Xaa at position 4 is Asn or Ile; Xaa at position 5 is Met, Ala or Ile; Xaa at position 6 is Ile, Pro or Leu; Xaa at position 9 is Ile, Ala or Leu; Xaa at position 11 is Thr or His; Xaa at position 15 is Gln, Arg, Val or Leu;

20 Xaa at position 18 is Leu, Ala, Asn or Arg; Xaa at position 20 is Leu or Ser; Xaa at position 23 is Phe, Pro, or Ser; Xaa at position 24 is Asn or Ala; Xaa at position 28 is Gly, Ala, Ser, Asp or Asn; Xaa at position 31 is Gln, Val, or Met; Xaa at position 32 is

25 Asp or Ser; Xaa at position 35 is Met, Ile, Leu or Asp; Xaa at position 36 is Glu or Asp; Xaa at position 37 is Asn, Arg or Ser; Xaa at position 41 is Arg, Leu, or Thr; Xaa at position 42 is Pro or Ser; Xaa at position 45 is Glu or Leu; Xaa at position 46 is Ala or Ser; Xaa

30 at position 48 is Asn, Val or Pro; Xaa at position 49 is Arg or His; Xaa at position 51 is Val or Ser; Xaa at position 53 is Ser, Asn, His or Gly; Xaa at position 55 is Gln or Glu; Xaa at position 59 is Ala or Gly; Xaa at position 62 is Ser, Ala or Pro; Xaa at position 65 is

35 Lys, Arg or Ser; Xaa at position 67 is Leu, Glu, or Val; Xaa at position 68 is Leu, Glu, Val or Trp; Xaa at position 71 is Leu or Val; Xaa at position 73 is Leu, Ser or Trp; Xaa at position 74 is Ala or Trp; Xaa

at position 77 is Ala or Pro; Xaa at position 79 is Pro or Ser; Xaa at position 81 is His or Thr; Xaa at position 84 is His, Ile, or Thr; Xaa at position 86 is Lys or Arg; Xaa at position 87 is Asp, Ala or Met; Xaa at position 91 is Asn or Gln; Xaa at position 95 is Arg, Glu, Leu; Xaa at position 98 Thr or Gln; Xaa at position 102 is Lys, Val, Trp or Ser; Xaa at position 103 is Thr or Ser; Xaa at position 106 is Asn, Gln, or His; Xaa at position 109 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native (15-125)human interleukin-3; and

- (b) transducing DNA into said cultured cells;
- (c) harvesting said transduced cells; and
- (d) transplanting said transduced cells into said patient.

14. The method according to Claim 11 wherein said interleukin-3 mutant polypeptide is selected from the group consisting of:

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 Glu Asp Val Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:66);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His

Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:67);

5 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
10 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:68);

15 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
20 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:69);

25 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
30 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:70);

35 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn

Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

5 (SEQ ID NO:71);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
10 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

15 (SEQ ID NO:72);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
20 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

25 (SEQ ID NO:73);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
30 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln

35 (SEQ ID NO:74);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly

Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 5 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln
 (SEQ ID NO:75);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 10 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 15 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:76);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 20 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
 25 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:77);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 30 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
 35 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln
 (SEQ ID NO:78);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 5 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:79);

10

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
 15 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:80);

20

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 25 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:81);

30

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
 35 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

Gln (SEQ ID NO:82);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
 5 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 10 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:83);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
 15 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 20 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
 Gln (SEQ ID NO:84);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 25 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
 Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
 30 Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
 Gln (SEQ ID NO:85);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
 35 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
 Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
 Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro

Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:86);

5 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
10 Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:87);

15 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
20 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:88);

25 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
30 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:89);

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu

Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 5 Gln (SEQ ID NO:90);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
 10 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 15 Gln (SEQ ID NO:91);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
 20 Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 25 Gln (SEQ ID NO:92);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
 30 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
 35 Gln (SEQ ID NO:93);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu

Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
5 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:94);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
10 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
15 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:95);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
20 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
25 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:96);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
30 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg
Leu Ser Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
35 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:296);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ala Ile His His
Leu Lys Arg Pro Pro Ala Pro Ser Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
5 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:300);

10

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
15 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:301);

20

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
25 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:308);

30

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
35 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

Gln (SEQ ID NO:309);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
 5 Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 10 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:310);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys
 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 15 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 20 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:315);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys
 25 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 30 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:316); and

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Leu Ile His His
 Leu Lys Ile Pro Pro Asn Pro Ser Leu Asp Ser Ala Asn Leu
 Asn Ser Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu

Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
5 Gln (SEQ ID NO:318).

15. The method of claim 10 wherein said mutant
human interleukin-3 polypeptide has at least three
times greater activity than native human interleukin-3,
10 in at least one assay selected from the group
consisting of: AML cell proliferation, TF-1 cell
proliferation and Methylcellulose assay.

16. The method of claim 10 further comprising the
15 step of separating the stem cells from a mixed
population of cells prior to culturing the stem cells.

17. The method of claim 16 wherein said stem
cells are separated from a mixed population of cells
20 based on the stem cells having CD34 surface antigen.

18. Transduced stem cells obtained by the method of claim
10, 11, 12, 13, 14, 15, 16, or 17.

25 19. A method for treatment of a patient having a
hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or
a blood donor;

30 (b) culturing said stem cells with a selected
growth medium comprising a human interleukin-3 mutant
polypeptide of (SEQ ID NO:15);

wherein Xaa at position 17 is Ser, Lys, Gly, Asp, Met, Gln, or
35 Arg;

Xaa at position 18 is Asn, His, Leu, Ile, Phe, Arg, or Gln;

Xaa at position 19 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;

Xaa at position 20 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;

- Xaa at position 21 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;
- Xaa at position 22 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val or Gly;
- 5 Xaa at position 23 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe, Ser, or Arg;
- Xaa at position 24 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
- Xaa at position 25 is Thr, His, Gly, Gln, Arg, Pro, or Ala;
- Xaa at position 26 is His, Thr, Phe, Gly, Arg, Ala, or Trp;
- 10 Xaa at position 27 is Leu, Gly, Arg, Thr, Ser, or Ala;
- Xaa at position 28 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;
- Xaa at position 29 is Gln, Asn, Leu, Pro, Arg, or Val;
- Xaa at position 30 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;
- 15 Xaa at position 31 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
- Xaa at position 32 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;
- Xaa at position 33 is Pro, Leu, Gln, Ala, Thr, or Glu;
- Xaa at position 34 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;
- 20 Xaa at position 35 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;
- Xaa at position 36 is Asp, Leu, or Val;
- Xaa at position 37 is Phe, Ser, Pro, Trp, or Ile;
- Xaa at position 38 is Asn, or Ala;
- Xaa at position 40 is Leu, Trp, or Arg;
- 25 Xaa at position 41 is Asn, Cys, Arg, Leu, His, Met, or Pro;
- Xaa at position 42 is Gly, Asp, Ser, Cys, Asn, Lys, Thr, Leu, Val, Glu, Phe, Tyr, Ile, Met or Ala;
- Xaa at position 43 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln, Arg, Thr, Gly or Ser;
- 30 Xaa at position 44 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu, Asn, Gln, Ala or Pro;
- Xaa at position 45 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Trp, Asp, Asn, Arg, Ser, Ala, Ile, Glu or His;
- Xaa at position 46 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys, His, Ala, Tyr, Ile, Val or Gly;
- 35 Xaa at position 47 is Ile, Gly, Val, Ser, Arg, Pro, or His;
- Xaa at position 48 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys, Thr, Ala, Met, Val or Asn;

- Xaa at position 49 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;
 Xaa at position 50 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala, Ile, Val, His, Phe, Met or Gln;
- 5 Xaa at position 51 is Asn, Arg, Met, Pro, Ser, Thr, or His;
 Xaa at position 52 is Asn, His, Arg, Leu, Gly, Ser, or Thr;
 Xaa at position 53 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, or Met;
- Xaa at position 54 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys, His, Ala or Leu;
- 10 Xaa at position 55 is Arg, Thr, Val, Ser, Leu, or Gly;
 Xaa at position 56 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His, Thr, Ala, Tyr, Phe, Leu, Val or Lys;
 Xaa at position 57 is Asn or Gly;
 Xaa at position 58 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- 15 Xaa at position 59 is Glu, Tyr, His, Leu, Pro, or Arg;
 Xaa at position 60 is Ala, Ser, Pro, Tyr, Asn, or Thr;
 Xaa at position 61 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
 Xaa at position 62 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
 Xaa at position 63 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- 20 Xaa at position 64 is Ala, Asn, Pro, Ser, or Lys;
 Xaa at position 65 is Val, Thr, Pro, His, Leu, Phe, or Ser;
 Xaa at position 66 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
 Xaa at position 67 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;
- 25 Xaa at position 68 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
 Xaa at position 69 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;
- Xaa at position 70 is Asn, Leu, Val, Trp, Pro, or Ala;
 Xaa at position 71 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
- 30 Xaa at position 72 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
 Xaa at position 73 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
 Xaa at position 74 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
 Xaa at position 75 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
- 35 Xaa at position 76 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;
 Xaa at position 77 is Ile, Ser, Arg, Thr, or Leu;

Xaa at position 78 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;

Xaa at position 79 is Lys, Thr, Asn, Met, Arg, Ile, Gly, or
Asp;

Xaa at position 80 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;

5 Xaa at position 81 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;

Xaa at position 82 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His,
Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;

Xaa at position 83 is Pro, Ala, Thr, Trp, Arg, or Met;

Xaa at position 84 is Cys, Glu, Gly, Arg, Met, or Val;

10 Xaa at position 85 is Leu, Asn, Val, or Gln;

Xaa at position 86 is Pro, Cys, Arg, Ala, or Lys;

Xaa at position 87 is Leu, Ser, Trp, or Gly;

Xaa at position 88 is Ala, Lys, Arg, Val, or Trp;

Xaa at position 89 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or
15 Ser;

Xaa at position 90 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;

Xaa at position 91 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;

Xaa at position 92 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile
or Leu;

20 Xaa at position 93 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;

Xaa at position 94 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,
Ala, or Pro;

Xaa at position 95 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,
Lys, Ser, Ala, Trp, Phe, Ile, or Tyr;

25 Xaa at position 96 is Pro, Lys, Tyr, Gly, Ile, or Thr;

Xaa at position 97 is Ile, Val, Lys, Ala, or Asn;

Xaa at position 98 is His, Ile, Asn, Leu, Asp, Ala, Thr,
Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;

Xaa at position 99 is Ile, Leu, Arg, Asp, Val, Pro, Gln,

30 Gly, Ser, Phe, or His;

Xaa at position 100 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,
or Pro;

Xaa at position 101 is Asp, Pro, Met, Lys, His, Thr, Val,
Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu, or Gln;

35 Xaa at position 102 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;

Xaa at position 103 is Asp, or Ser;

Xaa at position 104 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,
Gln, Lys, Ala, Phe, or Gly;

- Xaa at position 105 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,
Leu, Lys, Ile, Asp, or His;
Xaa at position 106 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
Xaa at position 108 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser,
5 Ala or Pro;
Xaa at position 109 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
Xaa at position 110 is Lys, Ala, Asn, Thr, Leu, Arg, Gln, His, Glu,
Ser, or Trp;
Xaa at position 111 is Leu, Ile, Arg, Asp, or Met;
10 Xaa at position 112 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
Xaa at position 113 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,
Lys, Leu, Ile, Val or Asn;
Xaa at position 114 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
Xaa at position 115 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,
15 Trp, or Met;
Xaa at position 116 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu,
Arg, Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;
Xaa at position 117 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
Xaa at position 118 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
20 Xaa at position 119 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;
Xaa at position 120 is Asn, Ala, Pro, Leu, His, Val, or Gln;
Xaa at position 121 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or
Gly;
Xaa at position 122 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,
25 Ile, Tyr, or Cys;
Xaa at position 123 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;
- wherein from 4 to 44 of the amino acids designated by
Xaa are different from the corresponding amino acids of
30 native (1-133) human interleukin-3; wherein from 1 to
14 amino acids can be deleted from the N-terminus
and/or from 1 to 15 amino acids can be deleted from the
C-terminus of said interleukin-3 mutant polypeptide;
and said interleukin-3 mutant polypeptide can
35 additionally be immediately preceded by Methionine⁻¹,
Alanine⁻¹ or Methionine⁻² Alanine⁻¹;

(c) harvesting said cultured stem cells; and

(d) transplanting said cultured stem cells into said patient.

20. A method for treatment of a patient having a
5 hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or a blood donor;

(b) culturing said stem cells with a selected
10 growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:19);

wherein

Xaa at position 3 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;

15 Xaa at position 4 is Asn, His, Leu, Ile, Phe, Arg, or Gln;

Xaa at position 5 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;

Xaa at position 6 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;

Xaa at position 7 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;

20 Xaa at position 8 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val, or Gly;

Xaa at position 9 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe, Ser, or Arg;

Xaa at position 10 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;

25 Xaa at position 11 is Thr, His, Gly, Gln, Arg, Pro, or Ala;

Xaa at position 12 is His, Thr, Phe, Gly, Arg, Ala, or Trp;

Xaa at position 13 is Leu, Gly, Arg, Thr, Ser, or Ala;

Xaa at position 14 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;

Xaa at position 15 is Gln, Asn, Leu, Pro, Arg, or Val;

30 Xaa at position 16 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;

Xaa at position 17 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;

Xaa at position 18 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;

Xaa at position 19 is Pro, Leu, Gln, Ala, Thr, or Glu;

35 Xaa at position 20 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;

Xaa at position 21 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;

Xaa at position 22 is Asp, Leu, or Val;

- Xaa at position 23 is Phe, Ser, Pro, Trp, or Ile;
 Xaa at position 24 is Asn, or Ala;
 Xaa at position 26 is Leu, Trp, or Arg;
 Xaa at position 27 is Asn, Cys, Arg, Leu, His, Met, Pro;
 5 Xaa at position 28 is Gly, Asp, Ser, Cys, Ala, Lys, Asn, Thr, Leu, Val, Glu, Phe, Tyr, Ile or Met;
 Xaa at position 29 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln, Arg, Thr, Gly or Ser;
 Xaa at position 30 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,
 10 Asn, Gln, Ala or Pro;
 Xaa at position 31 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Asp, Asn, Arg, Ser, Ala, Ile, Glu, His or Trp;
 Xaa at position 32 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys, His, Ala, Tyr, Ile, Val or Gly;
 15 Xaa at position 33 is Ile, Gly, Val, Ser, Arg, Pro, or His;
 Xaa at position 34 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys, Thr, Ala, Met, Val or Asn;
 Xaa at position 35 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;
 Xaa at position 36 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,
 20 Ile, Val, His, Phe, Met or Gln;
 Xaa at position 37 is Asn, Arg, Met, Pro, Ser, Thr, or His;
 Xaa at position 38 is Asn, His, Arg, Leu, Gly, Ser, or Thr;
 Xaa at position 39 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, Met, or;
 25 Xaa at position 40 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys, His, Ala or Leu;
 Xaa at position 41 is Arg, Thr, Val, Ser, Leu, or Gly;
 Xaa at position 42 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His, Thr, Ala, Tyr, Phe, Leu, Val or Lys;
 30 Xaa at position 43 is Asn or Gly;
 Xaa at position 44 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
 Xaa at position 45 is Glu, Tyr, His, Leu, Pro, or Arg;
 Xaa at position 46 is Ala, Ser, Pro, Tyr, Asn, or Thr;
 Xaa at position 47 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
 35 Xaa at position 48 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
 Xaa at position 49 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
 Xaa at position 50 is Ala, Asn, Pro, Ser, or Lys;
 Xaa at position 51 is Val, Thr, Pro, His, Leu, Phe, or Ser;

- Xaa at position 52 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
 Xaa at position 53 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;
 Xaa at position 54 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
 5 Xaa at position 55 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;
 Xaa at position 56 is Asn, Leu, Val, Trp, Pro, or Ala;
 Xaa at position 57 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
 10 Xaa at position 58 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
 Xaa at position 59 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
 Xaa at position 60 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
 Xaa at position 61 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
 15 Xaa at position 62 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;
 Xaa at position 63 is Ile, Ser, Arg, Thr, or Leu;
 Xaa at position 64 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
 Xaa at position 65 is Lys, Thr, Gly, Asn, Met, Arg, Ile, or Asp;
 20 Xaa at position 66 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;
 Xaa at position 67 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;
 Xaa at position 68 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
 25 Xaa at position 69 is Pro, Ala, Thr, Trp, Arg, or Met;
 Xaa at position 70 is Cys, Glu, Gly, Arg, Met, or Val;
 Xaa at position 71 is Leu, Asn, Val, or Gln;
 Xaa at position 72 is Pro, Cys, Arg, Ala, or Lys;
 Xaa at position 73 is Leu, Ser, Trp, or Gly;
 30 Xaa at position 74 is Ala, Lys, Arg, Val, or Trp;
 Xaa at position 75 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;
 Xaa at position 76 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;
 Xaa at position 77 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;
 35 Xaa at position 78 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;
 Xaa at position 79 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
 Xaa at position 80 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,

- Ala or Pro;
- Xaa at position 81 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn, Lys, Ser, Ala, Trp, Phe, Ile or Tyr;
- Xaa at position 82 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- 5 Xaa at position 83 is Ile, Val, Lys, Ala, or Asn;
- Xaa at position 84 is His, Ile, Asn, Leu, Asp, Ala, Thr, Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- Xaa at position 85 is Ile, Leu, Arg, Asp, Val, Pro, Gln, Gly, Ser, Phe, or His;
- 10 Xaa at position 86 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln, Pro;
- Xaa at position 87 is Asp, Pro, Met, Lys, His, Thr, Val, Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu or Gln;
- Xaa at position 88 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- 15 Xaa at position 89 is Asp, or Ser;
- Xaa at position 90 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu, Gln, Lys, Ala, Phe, or Gly;
- Xaa at position 91 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr, Leu, Lys, Ile, Asp, or His;
- 20 Xaa at position 92 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
- Xaa at position 94 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser, Ala, or Pro;
- Xaa at position 95 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
- Xaa at position 96 is Lys, Asn, Thr, Leu, Gln, Arg,
- 25 His, Glu, Ser, Ala or Trp;
- Xaa at position 97 is Leu, Ile, Arg, Asp, or Met;
- Xaa at position 98 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- Xaa at position 99 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp, Lys, Leu, Ile, Val or Asn;
- 30 Xaa at position 100 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
- Xaa at position 101 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr, Trp, or Met;
- Xaa at position 102 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu, Arg, Trp, Ser,
- 35 Asn, His, Ala, Tyr, Phe, Gln, or Ile;
- Xaa at position 103 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
- Xaa at position 104 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
- Xaa at position 105 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;

Xaa at position 106 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 107 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or Gly;

Xaa at position 108 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,
5 Ile, Tyr, or Cys;

Xaa at position 109 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by Xaa are different from the corresponding amino acids of
10 native (1-133) human interleukin-3; and said interleukin-3 mutant polypeptide can additionally be immediately preceded by Methionine⁻¹, Alanine⁻¹ or Methionine⁻² Alanine⁻¹;

15 (c) harvesting said cultured stem cells; and
(d) transplanting said cultured stem cells into said patient.

21. A method for treatment of a patient having a
20 hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or a blood donor;

(b) culturing said stem cells with a selected
25 growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:129);

wherein m is 0 or 1; Xaa at position 18 is Asn or Ile; Xaa at position 19 is Met, Ala or Ile; Xaa at position
30 20 is Ile, Pro or Leu; Xaa at position 23 is Ile, Ala or Leu; Xaa at position 25 is Thr or His; Xaa at position 29 is Gln, Arg, Val or Leu; Xaa at position 32 is Leu, Ala, Asn or Arg; Xaa at position 34 is Leu or Ser; Xaa at position 37 is Phe, Pro, or Ser; Xaa at
35 position 38 is Asn or Ala; Xaa at position 42 is Gly, Ala, Ser, Asp or Asn; Xaa at position 45 is Gln, Val, or Met; Xaa at position 46 is Asp or Ser; Xaa at position 49 is Met, Ile, Leu or Asp; Xaa at position 50

is Glu or Asp; Xaa at position 51 is Asn Arg or Ser;
Xaa at position 55 is Arg, Leu, or Thr; Xaa at position
56 is Pro or Ser; Xaa at position 59 is Glu or Leu; Xaa
at position 60 is Ala or Ser; Xaa at position 62 is
5 Asn, Val or Pro; Xaa at position 63 is Arg or His; Xaa
at position 65 is Val or Ser; Xaa at position 67 is
Ser, Asn, His or Gly; Xaa at position 69 is Gln or Glu;
Xaa at position 73 is Ala or Gly; Xaa at position 76 is
Ser, Ala or Pro; Xaa at position 79 is Lys, Arg or Ser;
10 Xaa at position 82 is Leu, Glu, Val or Trp; Xaa at
position 85 is Leu or Val; Xaa at position 87 is Leu,
Ser, or Trp; Xaa at position 88 is Ala or Trp; Xaa at
position 91 is Ala or Pro; Xaa at position 93 is Pro or
Ser; Xaa at position 95 is His or Thr; Xaa at position
15 98 is His, Ile, or Thr; Xaa at position 100 is Lys or
Arg; Xaa at position 101 is Asp, Ala or Met; Xaa at
position 105 is Asn or Gln; Xaa at position 109 is Arg,
Glu or Leu; Xaa at position 112 is Thr or Gln; Xaa at
position 116 is Lys, Val, Trp or Ser; Xaa at position
20 117 is Thr or Ser; Xaa at position 120 is Asn, Gln, or
His; Xaa at position 123 is Ala or Glu; with the
proviso that from four to forty-four of the amino acids
designated by Xaa are different from the corresponding
amino acids of native human interleukin-3;

25

(c) harvesting said cultured stem cells; and

(d) transplanting said cultured stem cells into
said patient.

30

22. A method for treatment of a patient having a
hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or
35 a blood donor;

(b) culturing said stem cells with a selected
growth medium comprising a human interleukin-3 mutant
polypeptide of (SEQ ID NO:130);

wherein m is 0 or 1; n is 0 or 1; p is 0 or 1; Xaa at
 position 4 is Asn or Ile; Xaa at position 5 is Met, Ala
 or Ile; Xaa at position 6 is Ile, Pro or Leu; Xaa at
 5 position 9 is Ile, Ala or Leu; Xaa at position 11 is
 Thr or His; Xaa at position 15 is Gln, Arg, Val or Leu;
 Xaa at position 18 is Leu, Ala, Asn or Arg; Xaa at
 position 20 is Leu or Ser; Xaa at position 23 is Phe,
 Pro, or Ser; Xaa at position 24 is Asn or Ala; Xaa at
 10 position 28 is Gly, Ala, Ser, Asp or Asn; Xaa at
 position 31 is Gln, Val, or Met; Xaa at position 32 is
 Asp or Ser; Xaa at position 35 is Met, Ile, Leu or Asp;
 Xaa at position 36 is Glu or Asp; Xaa at position 37 is
 Asn, Arg or Ser; Xaa at position 41 is Arg, Leu, or
 15 Thr; Xaa at position 42 is Pro or Ser; Xaa at position
 45 is Glu or Leu; Xaa at position 46 is Ala or Ser; Xaa
 at position 48 is Asn, Val or Pro; Xaa at position 49
 is Arg or His; Xaa at position 51 is Val or Ser; Xaa at
 position 53 is Ser, Asn, His or Gly; Xaa at position 55
 20 is Gln or Glu; Xaa at position 59 is Ala or Gly; Xaa at
 position 62 is Ser, Ala or Pro; Xaa at position 65 is
 Lys, Arg or Ser; Xaa at position 67 is Leu, Glu, or
 Val; Xaa at position 68 is Leu, Glu, Val or Trp; Xaa
 at position 71 is Leu or Val; Xaa at position 73 is
 25 Leu, Ser or Trp; Xaa at position 74 is Ala or Trp; Xaa
 at position 77 is Ala or Pro; Xaa at position 79 is Pro
 or Ser; Xaa at position 81 is His or Thr; Xaa at
 position 84 is His, Ile, or Thr; Xaa at position 86 is
 Lys or Arg; Xaa at position 87 is Asp, Ala or Met; Xaa
 30 at position 91 is Asn or Gln; Xaa at position 95 is
 Arg, Glu, Leu; Xaa at position 98 Thr or Gln; Xaa at
 position 102 is Lys, Val, Trp or Ser; Xaa at position
 103 is Thr or Ser; Xaa at position 106 is Asn, Gln, or
 His; Xaa at position 109 is Ala or Glu; with the
 35 proviso that from four to forty-four of the amino acids
 designated by Xaa are different from the corresponding
 amino acids of native (15-125)human interleukin-3;

(c) harvesting said cultured stem cells; and
(d) transplanting said cultured stem cells into
said patient.

5 23. The method according to Claim 20 wherein said
interleukin-3 mutant polypeptide is selected from the
group consisting of:

10 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
Glu Asp Val Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
15 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:66);

20 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
25 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:67);

30 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
35 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:68);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 5 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:69);

10

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 15 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:70);

20

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
 25 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
 (SEQ ID NO:71);

30

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
 35 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

(SEQ ID NO:72);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
5 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr
10 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

(SEQ ID NO:73);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
15 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr
20 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln

(SEQ ID NO:74);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
25 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr
30 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln

(SEQ ID NO:75);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
35 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile

Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
(SEQ ID NO:76);

5 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
10 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
(SEQ ID NO:77);

15 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys
20 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln
(SEQ ID NO:78);

25 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
30 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
(SEQ ID NO:79);

35 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn

Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

5 (SEQ ID NO:80);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
10 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

15 (SEQ ID NO:81);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
20 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

25 Gln (SEQ ID NO:82);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu
Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
30 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

35 Gln (SEQ ID NO:83);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His
Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu

Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg
Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu
Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
5 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:84);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
10 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
15 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:85);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
20 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
25 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:86);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
30 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
35 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:87);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
5 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:88);

10

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
15 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:89);

20

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
25 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:90);

30

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
35 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

Gln (SEQ ID NO:91);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
5 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
10 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:92);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
15 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
20 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:93);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
25 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
30 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:94);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu
35 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro

Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:95);

5 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val
10 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln
Gln (SEQ ID NO:96);

15 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg
Leu Ser Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
20 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:296);

25 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ala Ile His His
Leu Lys Arg Pro Pro Ala Pro Ser Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
30 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
Gln (SEQ ID NO:300);

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu

Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
5 Gln (SEQ ID NO:301);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg
10 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
15 Gln (SEQ ID NO:308);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
20 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
25 Gln (SEQ ID NO:309);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg
30 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
35 Gln (SEQ ID NO:310);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys
Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys

Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 5 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:315);

10 Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys
 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
 15 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
 (SEQ ID NO:316); and

20 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Leu Ile His His
 Leu Lys Ile Pro Pro Asn Pro Ser Leu Asp Ser Ala Asn Leu
 Asn Ser Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
 25 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
 Gln (SEQ ID NO:318).

30

24. The method of claim 19 wherein said mutant
 human interleukin-3 polypeptide has at least three
 times greater activity than native human interleukin-3,
 in at least one assay selected from the group
 35 consisting of: AML cell proliferation, TF-1 cell
 proliferation and Methylcellulose assay.

25. The method of claim 19 further comprising the

step of separating the stem cells from a mixed population of cells prior to culturing the stem cells.

26. The method of claim 25 wherein said stem cells
5 are separated from a mixed population of cells based on the stem cells having CD34 surface antigen.